June 17, 1958 E. J. McCARTHY 2,839,093

VACUUM FILLING MACHINE

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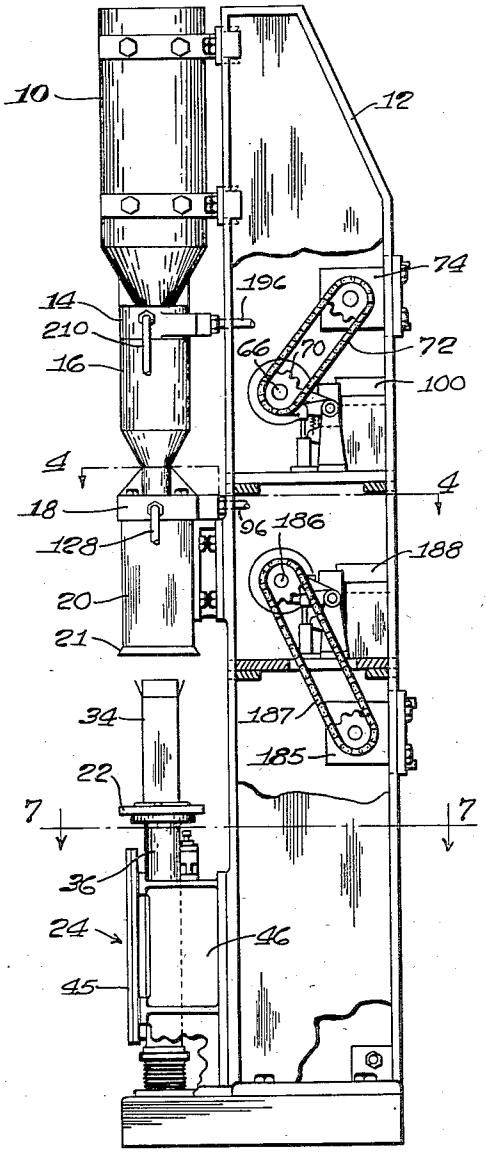


Fig. 1

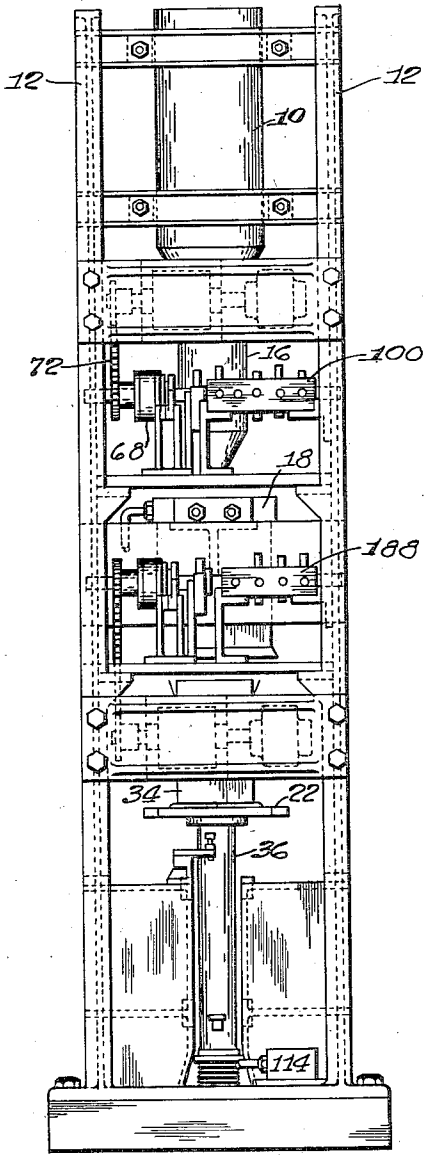


Fig. 2

INVENTOR.
Edward J. McCarthy
BY
J. Stanley Churchill
ATTORNEY

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VACUUM FILLING MACHINE

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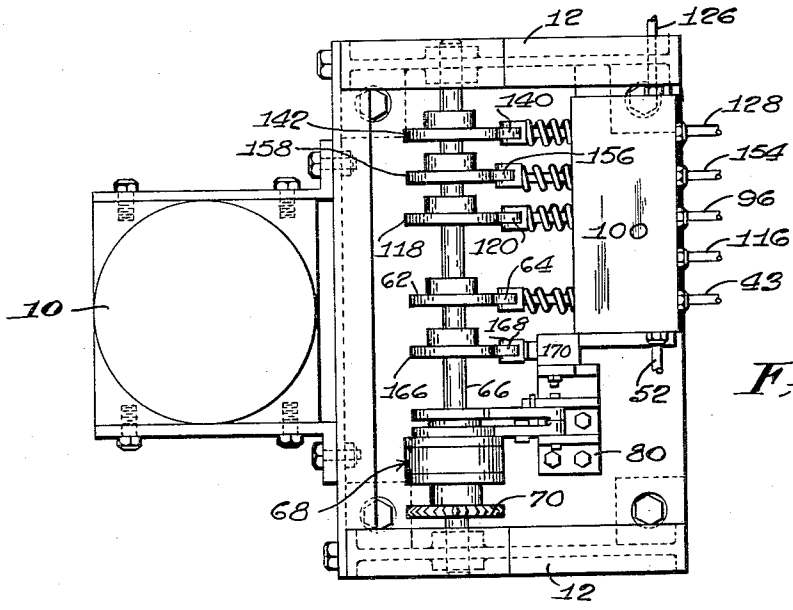


Fig. 3

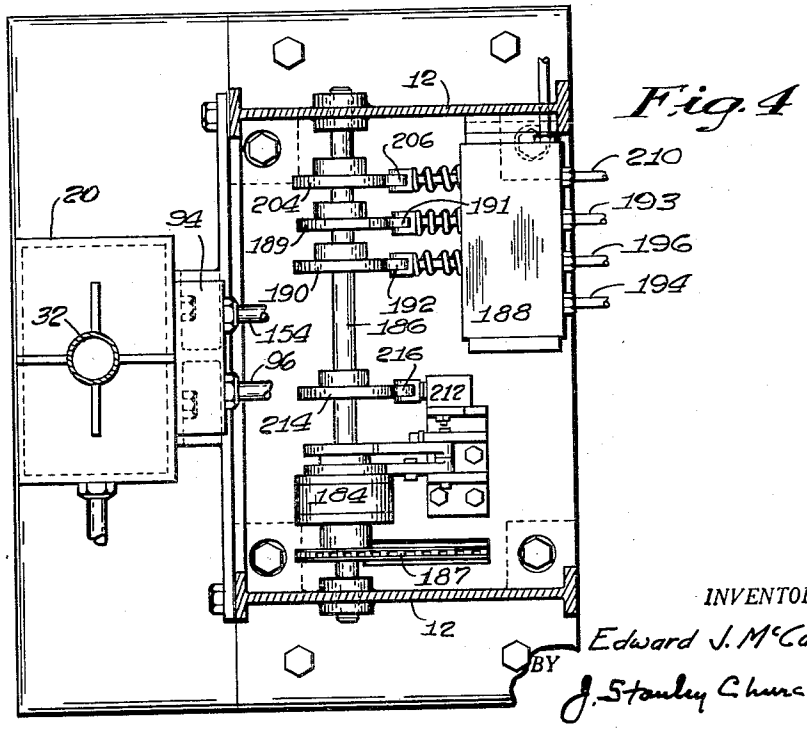


Fig. 4

INVENTOR.
Edward J. McCarthy
BY
J. Stanley Churchill
ATTORNEY

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VACUUM FILLING MACHINE

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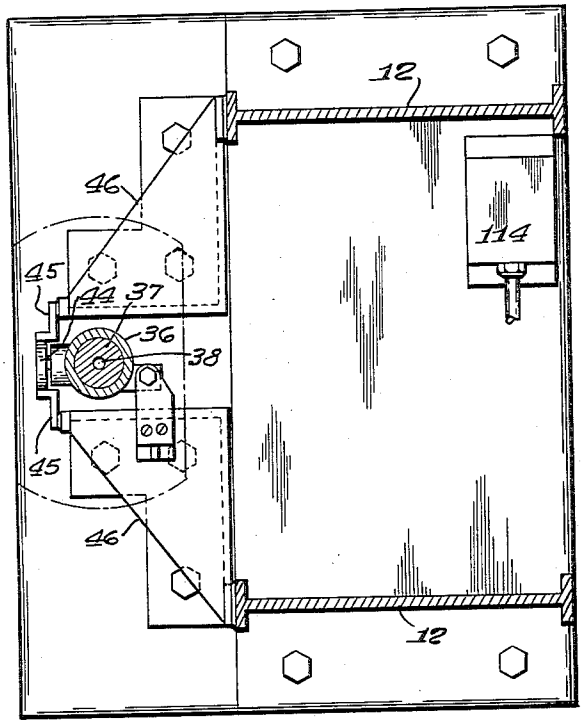



Fig. 17

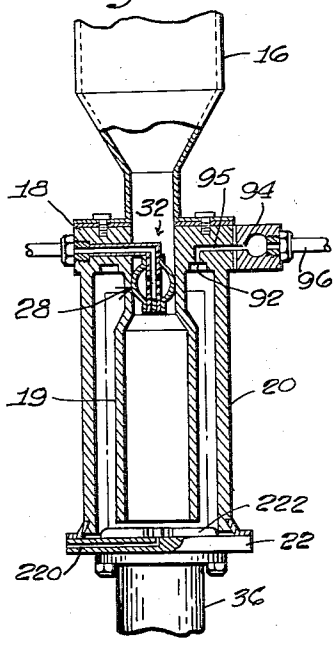



Fig. 7

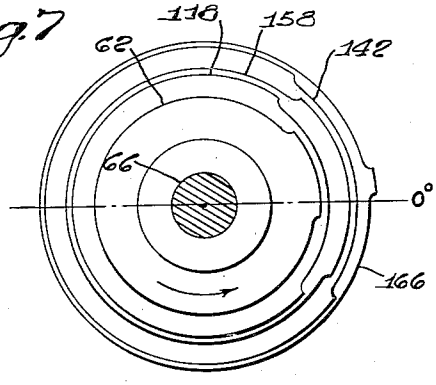



Fig. 5

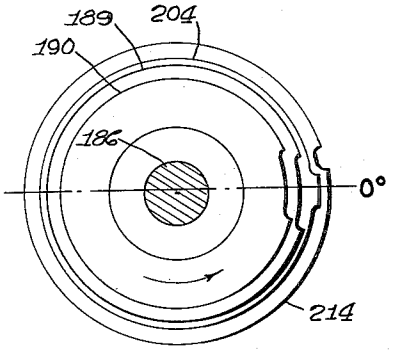
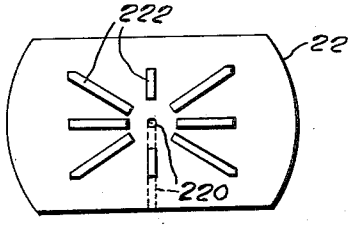



Fig. 6

Fig. 16




INVENTOR.
Edward J. McCarthy
BY J. Stanley Churchill
ATTORNEY

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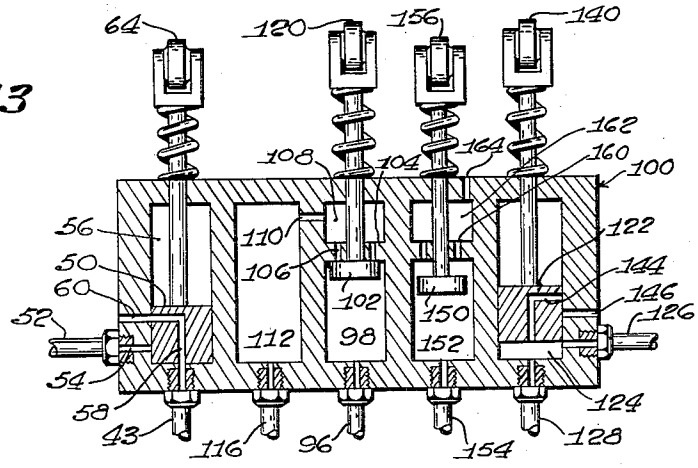
Fig. 13



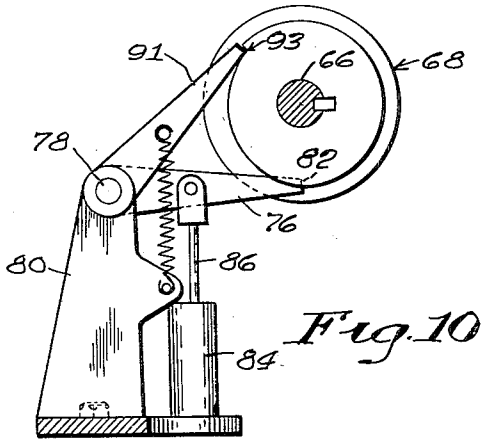




Fig. 10

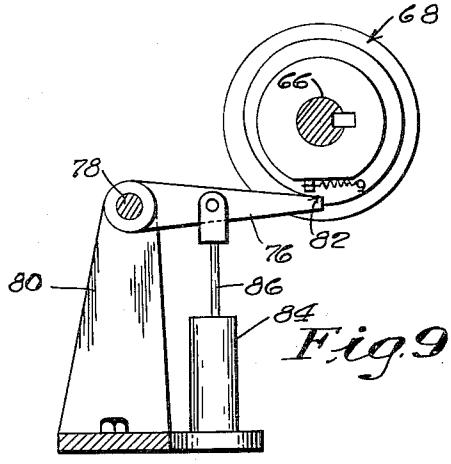



Fig. 9

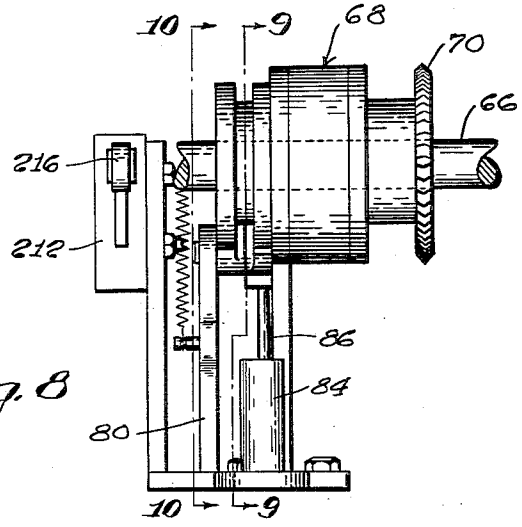



Fig. 8

INVENTOR.
Edward J. McCarthy
BY
J. Stanley Churchill
ATTORNEY

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Fig. 11

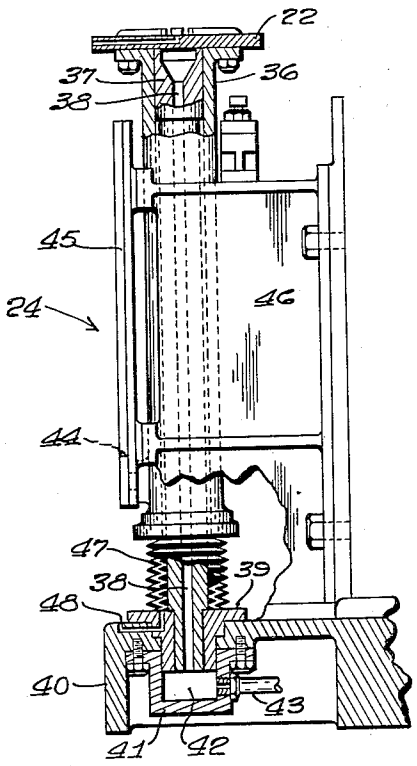
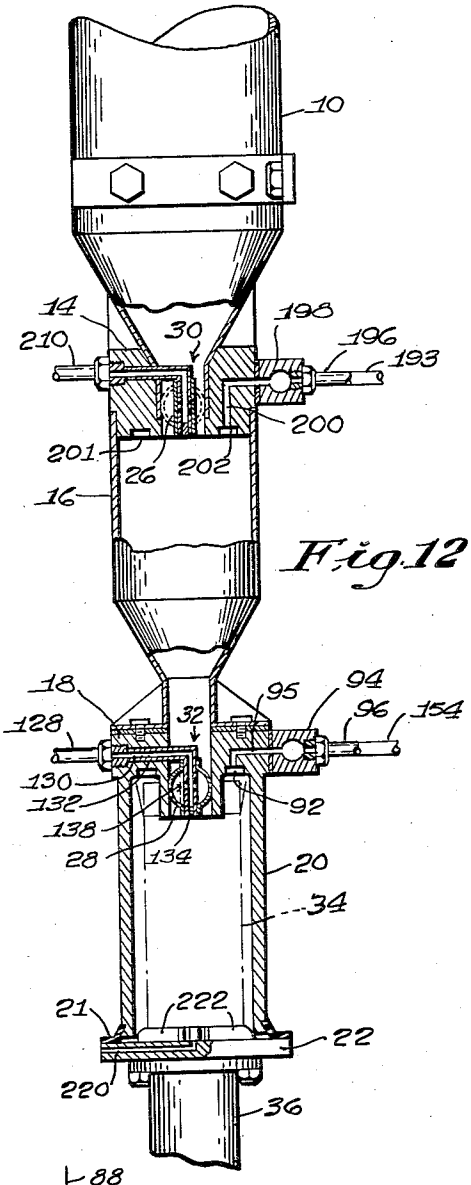



Fig. 12



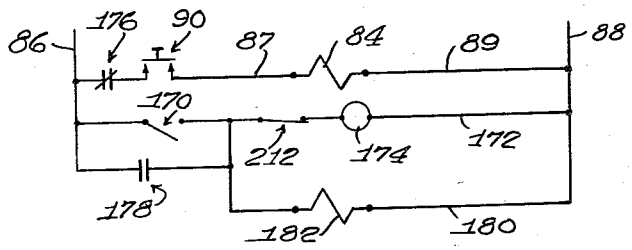




Fig. 15

INVENTOR.
Edward J. McCarthy
BY J. Stanley Churchill
ATTORNEY

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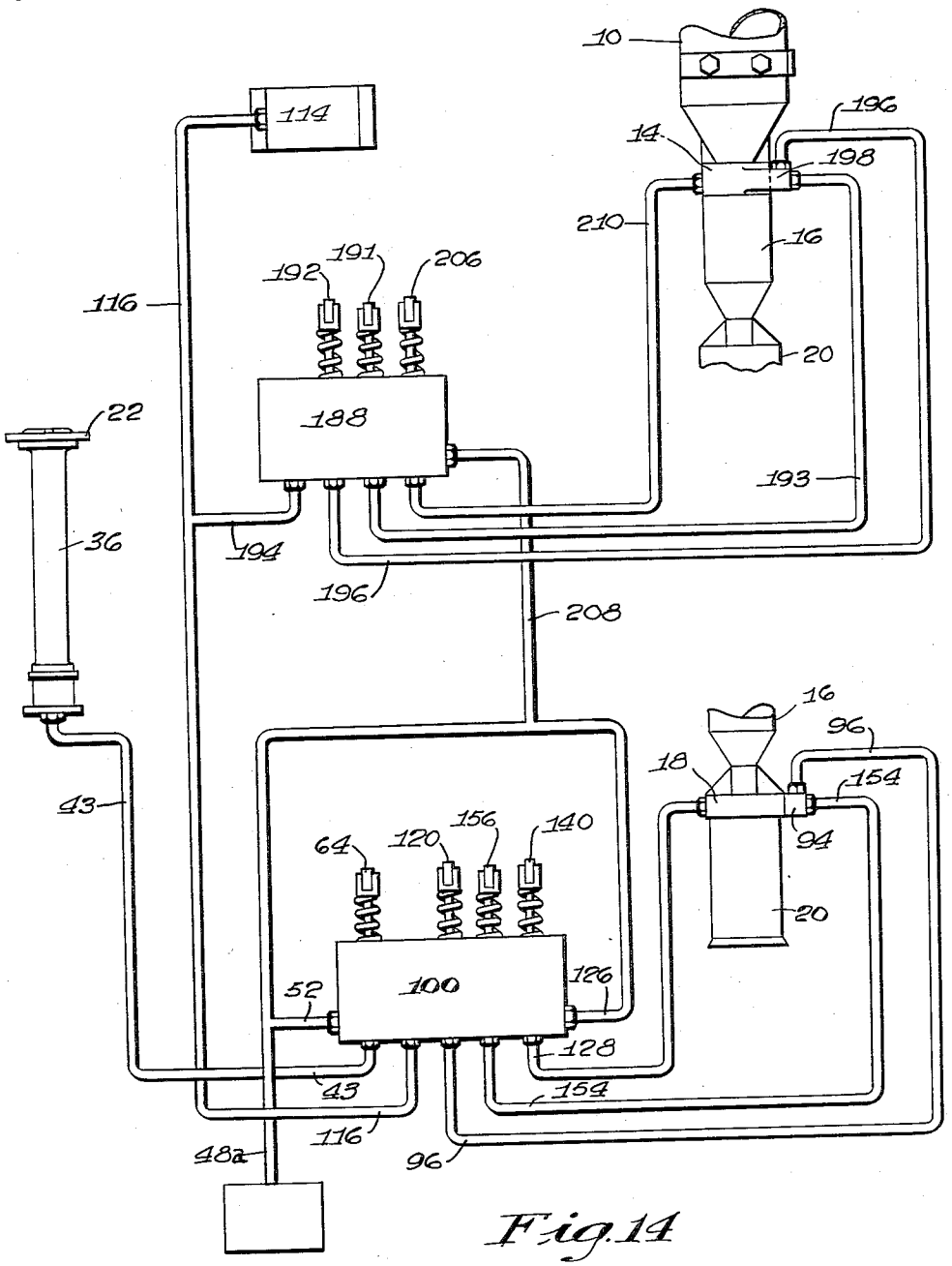


Fig. 14

INVENTOR.
Edward J. McCarthy
BY J. Stanley Churchill
ATTORNEY

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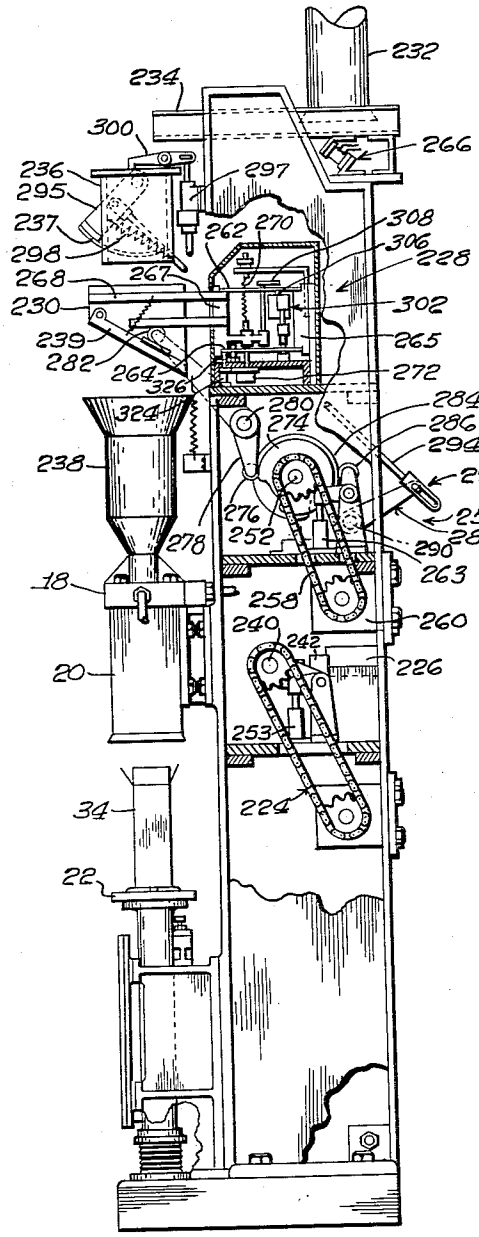


Fig. 18

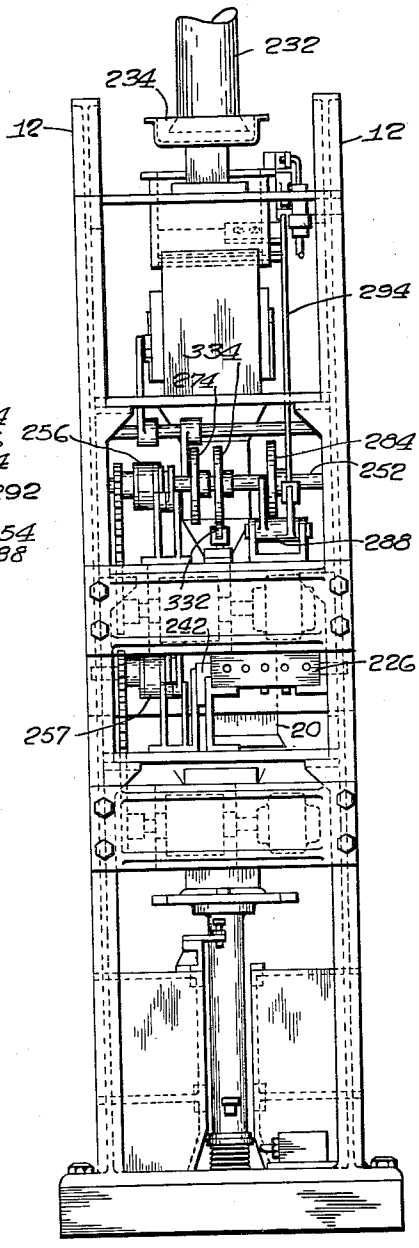


Fig. 19

INVENTOR.
Edward J. McCarthy
BY J. Stanley Churchill
ATTORNEY

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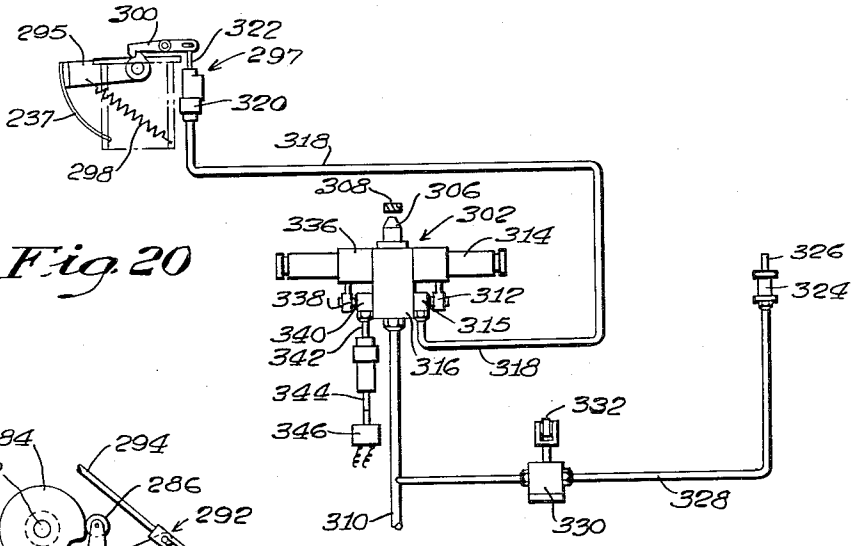


Fig. 20

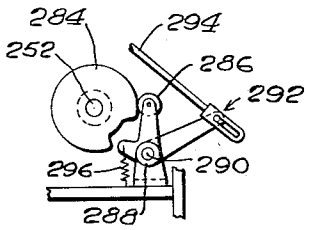


Fig. 23

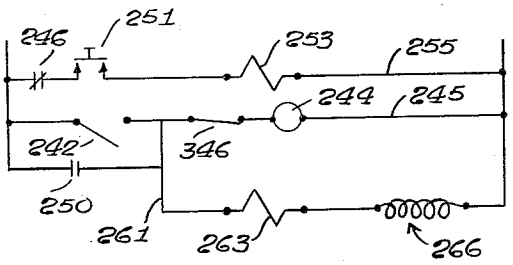


Fig. 21

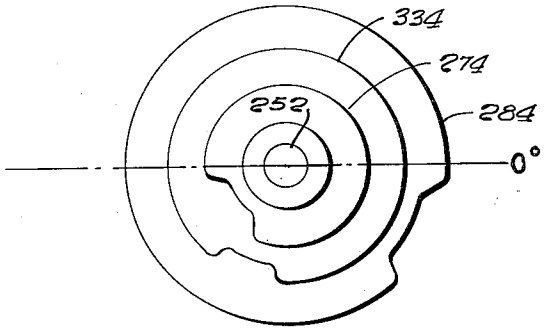


Fig. 22

INVENTOR.
Edward J. McCarthy
BY J. Stanley Churchill
ATTORNEY

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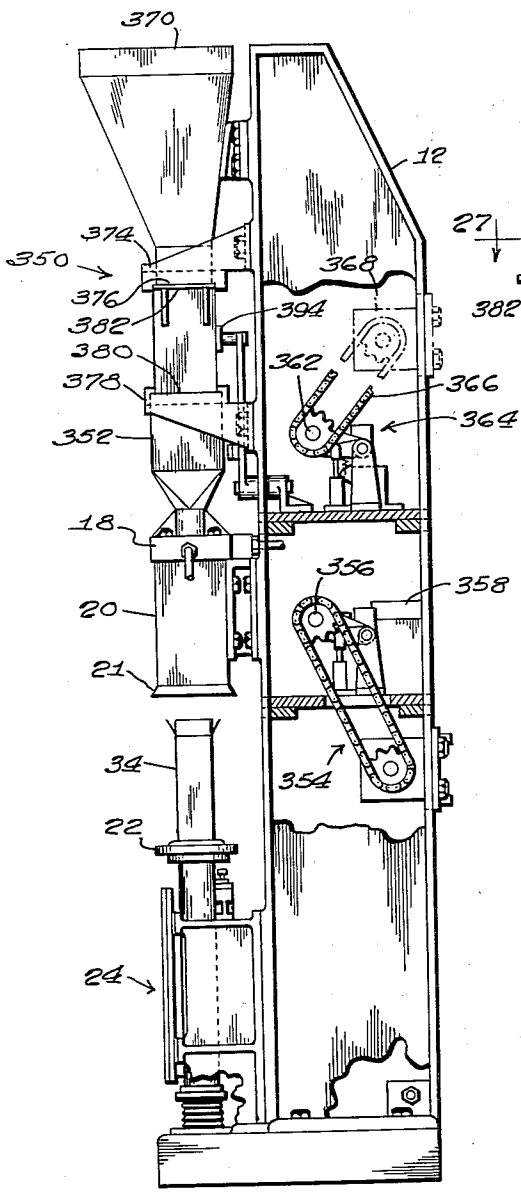


Fig. 24

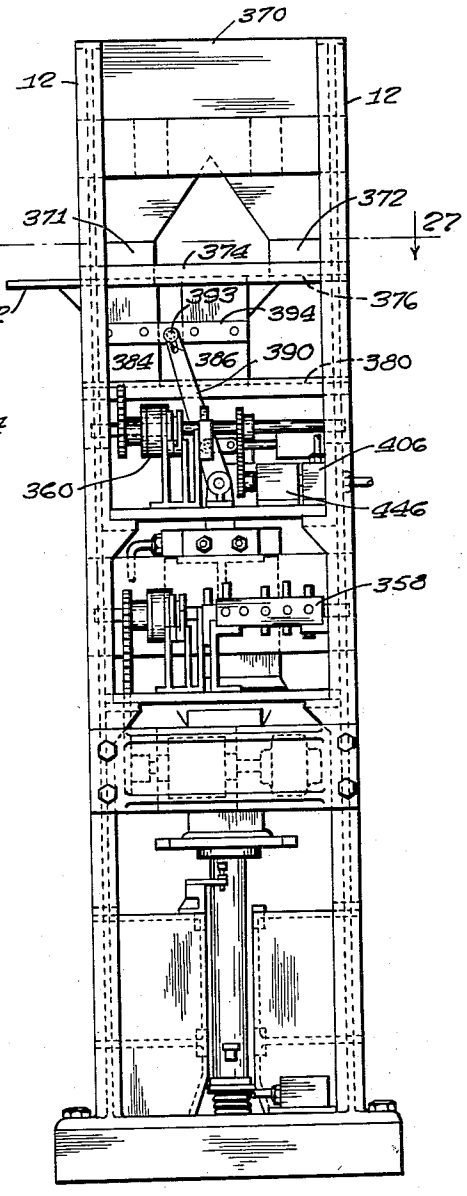


Fig. 25

INVENTOR.
Edward J. McCarthy
BY J. Stanley Churchill
ATTORNEY

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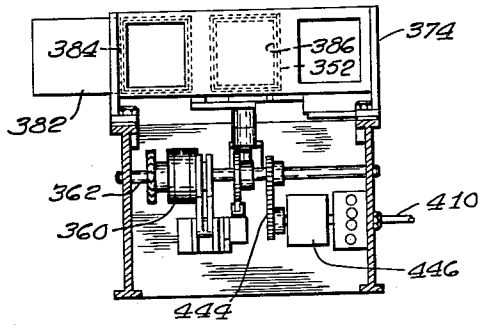



Fig. 27

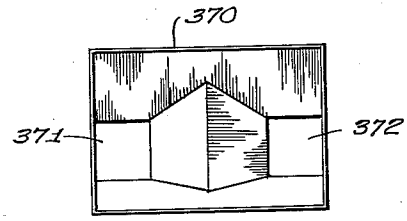



Fig. 26

Fig. 28

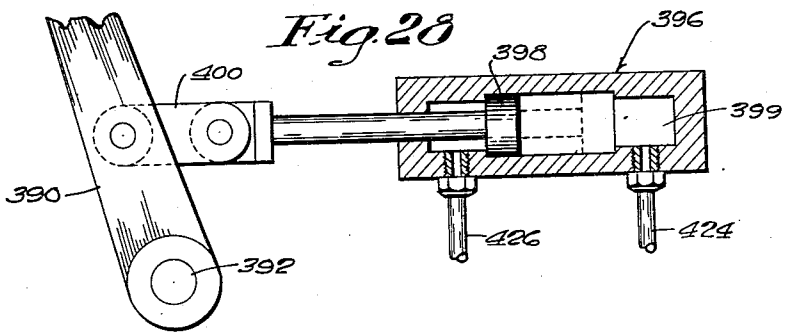



Fig. 29

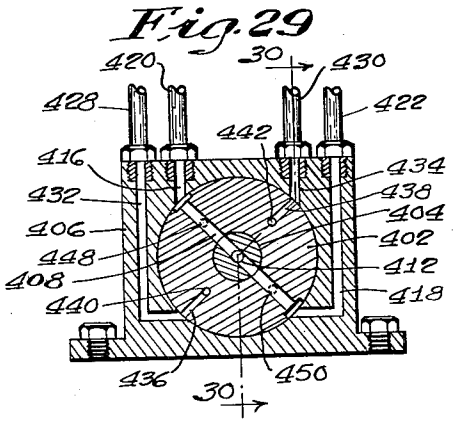
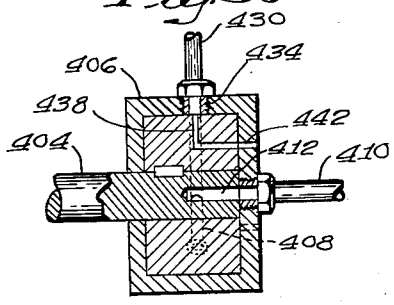



Fig. 30



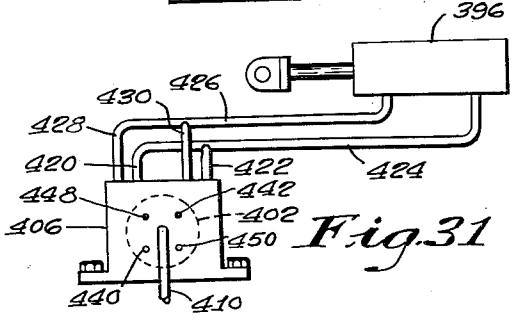




Fig. 31

INVENTOR.
Edward J. McCarthy
BY
J. Stanley Churchill.
ATTORNEY

United States Patent Office 2,839,093 Patented June 17, 1958



2,839,093

# VACUUM FILLING MACHINE

Edward J. McCarthy, Braintree, Mass., assignor to Pneumatic Scale Corporation, Limited, Quincy, Mass., a corporation of Massachusetts

Application June 9, 1955, Serial No. 514,297

18 Claims. (Cl. 141—51)

This invention relates to a vacuum filling machine for filling containers with finely divided or powdered solid materials.

The invention has for an object to provide a novel and improved vacuum filling machine of the character specified wherein provision is made for filling a container by vacuum with a preformed load of the finely divided material.

The invention has for a further object to provide a novel and improved vacuum filling machine of the character specified wherein provision is made for preforming predetermined loads of the material by the vacuum filling of a load forming chamber and then delivering the previously formed load into a container disposed within a shroud by a vacuum filling operation.

Another object of the invention is to provide a novel and improved vacuum filling machine of the character specified particularly adapted for vacuum filling containers and particularly irregularly-shaped containers, or relatively non-rigid or flexible containers, such as cartons or bags, with successive uniform loads of the material in a novel and highly efficient manner without the necessity of sealing the open mouth of the container.

With these general objects in view and such others as may hereinafter appear the invention consists in the vacuum-filling machine and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of the specification.

In the drawings illustrating the preferred embodiment of the invention:

Fig. 1 is a side elevation of a vacuum filling machine embodying the present invention;

Fig. 2 is a rear view of the machine shown in Fig. 1;

Fig. 3 is a plan view of the machine shown in Fig. 1;

Fig. 4 is a cross sectional plan view taken on the line 4—4 of Fig. 1;

Figs. 5 and 6 are side elevation views diagrammatically illustrating the cams for controlling the various operations of the machine to be described;

Fig. 7 is a cross sectional plan view of the machine as seen from the line 7—7 of Fig. 1;

Fig. 8 is a side elevation of clutch mechanism shown in Fig. 1 for controlling the operation of the machine;

Fig. 9 is a cross sectional view taken on the line 9—9 of Fig. 8;

Fig. 10 is a similar view taken on the line 10—10 of Fig. 8;

Fig. 11 is a detail view, partly in cross section, of elevating mechanism shown in Fig. 1;

Fig. 12 is a detail view, partly in cross section, of the load preforming and vacuum filling mechanism shown in Fig. 1;

Fig. 13 is a cross sectional view of pneumatic valve mechanism to be described;

Fig. 14 is a diagrammatic view of piping for the pneumatic control means;



Fig. 15 is a wiring diagram forming a part of the control mechanism;

Fig. 16 is a plan view of the container supporting platform forming a part of the elevator;

Fig. 17 is a cross sectional view of a modified form of the present filling mechanism;

Fig. 18 is a side elevation of a modified form of the present vacuum filling machine;

Fig. 19 is a rear view of the machine shown in Fig. 18;

Fig. 20 is a diagrammatic view of the pneumatic piping arrangement for pneumatic control mechanism embodied in the vacuum filling machine shown in Fig. 18;

Fig. 21 is a wiring diagram forming a part of the control mechanism for the machine shown in Fig. 18;

Fig. 22 is a side elevation view diagrammatically illustrating control cams for the weighing mechanism shown in Fig. 18;

Fig. 23 is a detail view of operating linkage forming a part of the control mechanism shown in Fig. 18;

Fig. 24 is a side elevation of another modified form of the present vacuum filling machine;

Fig. 25 is a rear view of the machine shown in Fig. 24;

Fig. 26 is a plan view of a supply hopper shown in Fig. 24;

Fig. 27 is a cross sectional plan view taken on the line 27—27 of Fig. 25;

Fig. 28 is a side elevation, partly in cross section, of pneumatic control means forming a part of the operating mechanism shown in Fig. 25;

Fig. 29 is a cross sectional view of a rotary control valve forming a part of the mechanism shown in Fig. 24;

Fig. 30 is a cross sectional view taken on the line 30—30 of Fig. 29; and

Fig. 31 is a diagrammatic view of the piping arrangement forming a part of the pneumatic control mechanism of the machine shown in Fig. 25.

In the operation of prior vacuum filling machines of which I am aware it has been necessary to engage the vacuum filling head in airtight sealing engagement with the mouth of the container to be filled and with the bottom of the filling head extended below the mouth of the container. In such machines the position of the bottom of the filling head defined the filling height in the container, and this together with the walls of the container defined the volume of material deposited therein upon evacuation and filling of the container. Thus, in practice in such prior vacuum filling machines the volume of the material in the vacuum filled container is limited by the filling level defined by the bottom of the filling head. In the filling of rigid containers of uniform size, uniform volumes of material in successive containers may be obtained by such prior filling practices. However, in the event that successive containers varied in size, the volumes in successive containers varied accordingly. In the filling of semi-rigid or non-rigid containers, such as flexible cardboard cartons or paper bags, difficulty is encountered in maintaining an airtight seal between the filling head and the mouth of the container. Accordingly, in filling non-rigid containers it is advantageous to avoid the necessity of sealing the mouth of the container during the filling operation.

In accordance with the present invention provision is made for assuring successive uniform loads in successive containers by first forming successive loads and then vacuum filling the preformed loads into the containers, and since preforming of the load eliminates the necessity for using the bottom of the filling head to limit the filling height or to define the volume, the container is preferably filled within a vacuum chamber or shroud and with the mouth thereof in non-sealing relation to the filling head, thus avoiding the necessity of attempting airtight sealing of the filling head with such non-rigid

and flexible containers and assuring uniform loads in successive containers irrespective of non-uniformity or irregularity in size and shape of the containers.

In the illustrated embodiment of the invention the container is placed on an elevator which is then elevated into sealing engagement with a vacuum filling head which is provided with a shroud enclosing the container within an airtight vacuum filling chamber, and upon operation of the machine the container is provided with a predetermined load of material previously formed in a receptacle disposed immediately thereabove. In the embodiment of the invention illustrated in Fig. 1 the receptable is of a size such as to form successive uniform loads, preferably by vacuum, the material being withdrawn from a supply hopper disposed immediately thereabove.

In another embodiment of the invention illustrated herein provision is made for preforming a load by first weighing the load and depositing the weighed load into a receptable and then withdrawing the preformed load by a vacuum filling operation from the receptacle depositing it in the container.

In still another embodiment of the invention provision is made for preforming successive loads by volumetric measuring devices adapted to deposit successive measured loads into a receptacle to be subsequently withdrawn by vacuum and delivered into the container, thus assuring successive uniform loads in successive containers irrespective of the irregularity of such containers.

Another novel feature of the present invention embodies means for causing a flow of air about the exterior surfaces of the container within the shroud during the vacuum filling operation whereby to prevent accumulation of the powdered material on the exterior surfaces of the container in a novel and efficient manner.

Referring now to the drawings and particularly to Fig. 1, in general **10** represents a supply hopper containing a supply of material and which is mounted on the side frames **12** of the vacuum filling machine. The lower end of the supply hopper **10** is operatively connected to the inlet of a vacuum filling head **14** forming a part of a receptacle **16** defining a volumetric measuring chamber, and in operation material is withdrawn by vacuum from the supply hopper **10** to preform a predetermined volumetric load in the chamber **16**. The lower end of the receptacle **16** is operatively connected to the inlet of a second vacuum filling head **18** having a depending shroud portion **20**, the lower end of which is arranged for sealing engagement with the upper surface of a container supporting platform **22**. The platform **22** is mounted on an elevating unit indicated generally at **24**, and in operation a container placed on the platform is elevated into the shroud portion **20**, and the platform moved into sealing engagement with the shroud to form an airtight vacuum filling chamber enclosing the container and with the mouth of the container free of sealing engagement with the filling head **18** as shown in Fig. 12. Normally closed expansible valve members **26**, **28** are provided in the inlets **30**, **32** respectively of the filling heads **14**, **18**, and in the operation of the machine provision is made for deflating the upper valve member **26** to permit the material to flow into the receptacle **16** to preform a measured load, and thereafter the valve member **26** is again expanded to close the inlet **30**, and the lower valve member **28** is deflated to open the inlet **32** to permit the preformed load to flow into the container **34** supported within the shroud **20**.

In the operation of the machine, during the initial period of a cycle of operation the elevating mechanism **24** is first operated to elevate the container into operative relation to the shroud **20** to effect vacuum filling of the container with a previously formed load contained in the measuring receptacle **16**, the filled container being returned to its lowered position upon completion of the vacuum filling operation, and during a succeeding period in the cycle of operation the measuring receptacle **16** is again provided with a measured load in readiness for a succeeding filling operation. As shown in Fig. 11, the container supporting platform **22** is mounted on and secured to the top of a pneumatically operated sleeve or cylinder **36** slidingly supported on a stationary rod **37** having a central bore **38**. The rod **37** is supported at its lower end in a flange member **39** attached to a base member **40** of the frame. An inverted cap member **41** secured to the underside of the base member **40** and fitted over the lower end of the flange member **39** forms an air chamber **42** to which a compressed air supply pipe **43** is connected. The chamber **42** communicates with the lower end of the central bore **38** in the rod **37**, and the upper end of the bore is flared as shown and is closed by the underside of the elevating platform **22** when the latter is in its lowered position as illustrated in Fig. 11.

In operation when compressed air is permitted to enter the chamber **42** the elevating platform with its sleeve **36** is caused to rise on the supporting rod **37** to elevate a container into operative relation to the shrouded vacuum filling head. The sleeve **36** with its platform **22** is prevented from rotation on its own axis by a roller **44** movable in a vertical guide formed by angle bars **45** secured to supporting brackets **46** as shown in Fig. 7. As illustrated in Fig. 12, the lower end of the shroud **20** is provided with a skirt **21** of rubber or other resilient material for airtight sealing engagement with the platform. The lower end of the cylinder **36** is connected by an expansible bellows **47** to the upper surface of the flanged member **39**. A passageway **48** formed in the flange **39** is open to the atmosphere and communicates with the interior of the bellows as shown. It will be observed that the central supporting rod **37** is reduced in diameter immediately below the upper end thereof forming an annular space between the rod and its sleeve. Thus, in operation when the cylinder **36** is elevated to expand the bellows **47** air may be drawn in through the passageway **48**, and conversely, when the cylinder **36** is lowered the air within the bellows may be exhausted through the passageway **48**. The bellows **47** provides protection from dust, and opening **48** may be connected to a dust-free area or provided with a filter, not shown.

The operating mechanism for controlling the elevation of the container supporting platform **22** includes a spring pressed and cam operated valve member indicated at **50** in Fig. 13 operating in a chamber **56** formed in a multiple valve housing **100** and included in the piping diagram shown in Fig. 14. As therein shown, a pipe **48***a* leading from a source of compressed air is connected by a pipe **52** through an inlet **54** to the chamber **56**, the inlet **54** being normally closed by the valve member **50** as shown in Fig. 13. In such position the pipe line **43** connected to the chamber **42** of the elevating mechanism is opened to the atmosphere through communicating passageways **58**, **60** formed in the valve member **50** and housing **100** respectively as shown. The spring pressed valve member **50** is arranged to be operated by a cam **62** cooperating with a cam roll **64** carried by the stem of the valve member **50**. The cam **62**, as shown in Fig. 3, is fast on a one revolution cam shaft **66** supported in bearings formed in the side frames **12** of the machine and is arranged to be driven through connections including a one revolution clutch of conventional design and indicated generally at **68**. The driving member of the clutch is provided with a sprocket **70** connected by a chain and sprocket drive **72** to a motor **74**, the driven member of the clutch being normally disengaged from the driving member by a solenoid operated latch **76** as shown in detail in Fig. 10. The latch member **76** is pivotally mounted at **78** in a bracket **80** attached to the machine frame and is arranged to engage a notch **82** formed in the clutch member to maintain the clutch in non-driving engagement. A solenoid **84** is connected to the latch member by a link

86, and in operation upon energizing the solenoid 84, the latch member is rocked downwardly to release the clutch to permit the shaft 66 to make one revolution, the shaft coming to rest upon re-engagement of the latch 76 in the notch 82. As indicated in Fig. 15, the solenoid 84 forms part of a control circuit which includes supply leads 86, 88 and leads 87, 89 having a push button switch 90 so that in operation pressing of the push button 90 will energize the solenoid 84 to rock the latch member 76 downwardly to release the clutch unit 68. A second latch 91 shown in Fig. 10 may be spring pressed to engage a second notch 93 formed in the clutch member for the purpose of preventing back lash of the shaft 66 when abruptly brought to rest by the latch member 76.

Upon elevation of the container into the shroud and sealing engagement of the supporting platform 22 with the lower end of the shroud, provision is made for evacuating the shroud member and withdrawing the preformed load from the measuring receptable 16 into the container 34. As shown in Fig. 12, the filling head 18 is provided with an annular suction inlet 92 which communicates through a passageway 95 with a manifold 94 having a suction pipe 96 connected to a valve chamber 98 forming a part of the multiple valve housing 100. The valve chamber 98 is provided with a cam operated and spring pressed valve member 102, the chamber 98 being provided with a partition 104 provided with passageways 106 communicating with an upper chamber 108 which in turn is connected by passageway 110 to a vacuum chamber 112. The chamber 112 may be connected to a source of vacuum indicated diagrammatically at 114 by a pipe 116. The spring pressed valve member 102 is arranged to be actuated by a cam 118 fast on the cam shaft 66 which cooperates with a cam roll 120 carried by the stem of the valve member 102.

In the operation of the machine, immediately after sealing engagement of the platform 22 with the shroud 20, the valve member 102 is depressed to permit the flow of air to evacuate the shroud chamber, and simultaneously therewith or immediately thereafter, provision is made for deflating the normally inflated valve member 28 to open the inlet 32 and thus effect withdrawal of the previously measured load from the measuring receptacle 16. As illustrated in Fig. 13, the mechanism for controlling the member 28 includes a control valve 122 slidingly mounted in a chamber 124 which is connected to a source of compressed air by a pipe 126, the chamber 124 being connected by a pipe 128 to the filling head 18, as shown in Figs. 12 and 13. The pipe 128 communicates with passageways 130 formed in a conduit 132 extended through one side of the filling head, the conduit 132 having its inner end bent downwardly at right angles and disposed in alignment with the axis of the inlet 32. The lower end of the conduit 132 is provided with a plug 134. The member 28 comprises an annular resilient tube connected at its upper and lower ends in airtight relation to the vertical portion of the conduit 132 and is arranged to communicate with the compressed air passageways 130 through lateral openings 138 formed in the conduit 132 as clearly shown in Fig. 12. The control valve 122 is provided with a cam roll 140 arranged to cooperate with a cam 142 fast on the cam shaft 66, and in operation immediately after the shroud chamber is evacuated, the control valve 122 is actuated to align passageways 144 formed therein with an atmospheric opening 146 formed in the housing 100 whereby to permit deflation of the resilient valve member 28 and opening of the inlet 32.

Upon completion of the vacuum filling operation and complete withdrawal of the load from the receptacle 16 into the container, the vacuum to the shroud is discontinued by operation of the valve member 102, and the shroud chamber is then arranged to be opened to the atmosphere by a cam operated valve member 150 as shown in Fig. 13. The valve member 150 operates in a valve chamber 152 connected by a pipe 154 to the manifold 94 shown in Fig. 4 and which is arranged to communicate with the annular passageway 92 formed in the filling head 18 whereupon the valve member 28 is again expanded to close the inlet 32 by operation of the control valve 122. The stem of the spring pressed valve 150 is provided with a cam roll 156 arranged to cooperate with a cam 158 fast on the cam shaft 66, and the chamber 152 is arranged to communicate through passageways 160 with a chamber 162 having an opening 164 to the atmosphere. Upon opening of the shroud 20 to the atmosphere the elevating cam 62 operates to move the valve member 50 into a position to open the elevator chamber 42 to the atmosphere through line 43 and passageways 58, 60 whereupon the elevator will descend with a filled container on the platform 22. It will be understood that in operation the chamber 16 is normally open to the atmosphere through similar valve controlled connections in the filling head 14 during the withdrawal of the material therefrom to permit the flow of material into the container, as will be hereinafter described.

From the description thus far it will be observed that during one period in a cycle of operation of the vacuum filling machine a container placed on the platform 22 is elevated into operative relation to the shroud 20 whereupon the container is vacuum filled with a preformed load withdrawn from the receptacle 16, and upon filling of the container the platform 22 is permitted to descend to its initial position. During the second period in a cycle of operation of the vacuum filling machine provision is made for preforming a succeeding load in the receptacle 16 to be subsequently withdrawn into a succeeding container during the next cycle of operation. As herein shown, in order to initiate filling of the receptacle 16 the one revolution cam shaft 66 is provided with a cam 166 arranged to cooperate with a cam roll 168 forming part of a switch 170. The switch 170 forms part of a circuit 172 having a relay 174 as shown in Fig. 15, and as the cam shaft approaches the end of its revolution the cam 166 effects closing of the switch 170 to energize the relay 174. The relay 174 is arranged to open the circuit to the solenoid 84 at a normally closed switch 176 and to simultaneously close a switch 178 in a circuit 180 provided with a solenoid 182. The solenoid 182 is operatively connected to a latch member similar to latch 76 for controlling the operation of a one revolution clutch 184 mounted on a lower cam shaft 186 as shown in Fig. 4, such solenoid and associated connections being similar to those shown in Figs 8, 9 and 10 for controlling the upper cam shaft 66. The lower cam shaft 186 is arranged to be driven from a motor 185 connected to the one revolution clutch by a chain and sprocket drive 187. As shown in Fig. 4, the shaft 186 is provided with a plurality of cams arranged to cooperate with control valves carried by a multivalve housing 188 which may be similar to the multivalve housing 100 shown in Figs. 3 and 13 except that the valve 50 for operating the elevating mechanism is eliminated. Thus, in the operation of the machine when the lower cam shaft 186 is released to permit it to rotate one revolution a cam 190, cooperating with a roller 192 carried by a valve similar to 102 and operating in a similar valve chamber, is arranged to effect depression of the valve to permit the flow of air from the source of vacuum through a pipe 194 to the vacuum chamber, then through the adjacent valve chamber and connecting pipe 196 to a manifold 198, see Figs. 12 and 14, communicating with the filling head 14 through passageway 200 and annular passageway 202 to the interior of the receptacle 16 to evacuate the same. Simultaneously therewith or immediately thereafter, the normally expanded valve member 26 is deflated by operation of a cam 204 cooperating with a cam roll 206 carried by a valve member similar to 122 shown in Fig. 13 and operating in a chamber connected to a source of compressed air by a pipe 208. The chamber is also connected by a pipe 210 to the inflatable valve unit 26 in

the filling head 14. The cam operated valve is provided with passageways for alignment with an atmospheric opening in the housing 188 operating in a manner similar to that above described. The receptacle 16 is arranged to be opened to the atmosphere by a cam 189 cooperating with a cam roll 191 carried by a valve similar to 150 in the multivalve housing 188. The valve chamber is connected by a pipe 193 to the manifold 198 for communication with the interior of the receptacle in a manner similar to that described with respect to the filling head 18. A screen 201 may cover passageway 202.

Thus, in the operation of the machine, upon evacuation of the measuring receptacle 16, material is withdrawn from the supply hopper 10 into the measuring receptacle to form a predetermined load therein. Thereafter, the vacuum is discontinued through operation of the cam 190; the receptacle is opened to the atmosphere through the operation of the cam 189 and remains open to the atmosphere during subsequent withdrawal of the material therefrom; and the inflatable valve 26 is again closed through operation of the cam 204 to complete preforming of the load in readiness to be subsequently withdrawn into a succeeding container presented in operative relation to the shroud 20 as above described. As shown in Figs. 4 and 15, a switch 212 in the relay circuit 172 is arranged to be opened by a cam 214 and roller 216 as the cam shaft 186 approaches the end of its revolution to deenergize the relay 174 whereby the switches 176, 178 may again assume their normal positions in readiness for a succeeding cycle of operation by manual pressing of the push button 90 as described.

It will be observed that a container placed on the platform 22 is elevated into operative relation to the shroud 20, and a previously formed measured load is withdrawn from the receptacle 16 by vacuum and deposited into the container without sealing engagement of the filling head with the mouth of the container to provide a predetermined load in the container irrespective of variations in the size and shape thereof. It will thus be seen that the present vacuum filling machine is of particular advantage in filling irregularly shaped containers and also non-rigid containers, such as paper bags, with successive uniform loads of material.

In a modified form of vacuum filling head, illustrated in Fig. 17, provision is made for handling containers, such as bags made of a relatively thin and lightweight material, which may be displaced from the platform 22 during the elevating operation or which may be incapable of maintaining an upright position during the vacuum filling operation. As shown in Fig. 17, the filling head 18 may be provided with a central depending hollow portion 19 forming an extension of the inlet 32. The hollow portion 19 is open at its lower end and may be of a cross sectional shape, such as to fit loosely within the relatively thin bag and thus support the same in an upright position on the platform 22 during the filling operation. In operation the material withdrawn from the receptacle 16 into the hollow portion 19 during the filling operation is subsequently deposited into the container by gravity during the descent of the platform with the container.

Referring now to Figs. 12 and 16, provision is made in the illustrated and preferred embodiment of the invention for preventing the accumulation of the powdered material on the exterior of the container during the vacuum filling operation. As herein shown, the platform 22 is provided with a vent opening 220 extending through one side thereof and upwardly to the center of the platform. The upper surface of the platform is provided with a plurality of radially arranged raised portions 222 upon which the container is supported to provide a clearance between the upper surface of the platform and the bottom of the container. In the operation of the machine air will be drawn in from the atmosphere through the vent opening 220 and will flow along the bottom surface of the container between the raised portions 222 and along the side walls of the container and into the suction openings 92, 95. In practice the vent opening 220 may be relatively small so that any reduction in pressure in the shroud chamber during the vacuum filling operation is practically negligible. However, the stream of air drawn in through the vent opening and around the exterior surfaces of the container is sufficient to maintain the exterior surfaces of the container being filled free of the powdered or finely divided material.

In the embodiment of the invention illustrated in Figs. 1 to 15 the load is preformed by vacuum to produce a predetermined load in a volumetric measuring receptacle 16, which load is subsequently withdrawn from the receptacle and deposited into the container to be filled. The vacuum filling of the measuring receptacle 16 is of particular advantage in that it also serves to deaerate the comminuted material prior to delivery to the container whereby the material is more closely packed within the container and is rendered less subject to excessive settling of the material in the filled container.

In a modified form of the invention, as illustrated in Figs. 18 to 23, provision is made for preforming loads of predetermined weight, the weighed load being deposited into a receptacle to be subsequently withdrawn by vacuum and introduced into the container. As illustrated in Figs. 18 and 19, the vacuum filling mechanism for withdrawing a preformed load from a receptacle and introducing the load into a container may and preferably will comprise the vacuum filling mechanism previously described in the embodiment of the invention illustrated in Figs. 1 and 2 and includes the filling head, shroud 20 and elevating platform 22 on which the container 34 is elevated into operative engagement with the shroud 20. Also, the driving mechanism, indicated generally at 224, and the control mechanism including the cam operated control valves, indicated generally at 224, and the control mechanism including the cam operated control valves, indicated generally at 226, may and preferably will comprise the corresponding mechanisms previously described.

As shown in Fig. 18, the weighing mechanism for preforming the load in the modified form of the invention includes a pneumatically controlled cantilever type weighing unit, indicated generally at 228, having a weighing bucket 230 into which material is caused to flow from a supply thereof through a supply pipe 232, vibratory feeder 234, and material cutoff chamber 236, having a pivoted cutoff blade 237. In the operation of the machine a previously weighed load contained in the weighing bucket 230 is released by mechanically opening the spring closed pivoted shutter 239 to permit the load to fall by gravity into the open top of a receptacle 238 having its lower end in communication with the material inlet in the filling head 18. It will be understood that in operation the vacuum filling operation is performed during the initial period in a cycle of operation of the machine and is initiated by pressing a push button switch 251 to energize the solenoid 253 in the circuit 255 shown in Fig. 21 to permit the one revolution clutch 257 to make one revolution whereby the previously deposited load contained in the receptacle 238 is withdrawn and deposited in the container, and that during a second period of the cycle the weighing operation is performed to provide a preformed load in readiness for a succeeding cycle of operation. Thus, as indicated in Fig. 21, when the cam shaft 240, forming a part of the drive mechanism 224, approaches the end of its one revolution, the cam operated switch 242 is closed to energize the relay 244 in the circuit 245, thus opening the normally closed switch 246 in the circuit 255 controlling the vacuum filling operation and closing the normally open switch 250 in the circuit 261 to energize the solenoid 263 and initiate operation of the one revolution shaft 252 forming a part of the drive indicated generally at 254 for controlling the weighing operation. The drive shaft 252 may be provided with a one revolution clutch 256 controlled by solenoid operated

latch mechanism, as previously described, and connected by a chain and sprocket drive 258 to a motor 260. Closing of the circuit 261 is also arranged to energize the vibratory motor 266 to start the vibratory feeder 234.

Upon starting of the one revolution shaft 252 the shutter 239 is first opened by a cam 274 fast on the cam shaft 252 and which cooperates with a roller 276 carried by one arm 278 of a two-armed lever pivoted at 280, the other arm having a roller 282 cooperating with a bearing plate formed on the shutter 239. After the previously weighed load has been released from the weighing bucket the shutter 239 is immediately spring closed, and thereafter the material cutoff blade 237 is arranged to be rocked from its spring-closed position, as shown in Fig. 18 to a latched open position as shown in Fig. 20. As seen in Figs. 18 and 23, the cutoff blade is arranged to be rocked by a cam 284 fast on the shaft 252 and cooperating with a roller 286 carried by one arm of a bell crank 288 pivoted at 290, the other arm of the bell crank being engaged by a pin and slot connection 292 with a link 294 connected to the cutoff blade arm 295. A spring 296 connected to an extended portion of the bell crank 288 is arranged to hold the roller against its cam 284, and a spring 298 connected to the cutoff blade arm 295 is arranged to urge the blade into a closed position. The blade 237 is held in its open position by a pivoted latch member 300 engaged with a notch formed in the hub of the arm 295 and is arranged to be released to cut off the feed of the material by a pneumatic control unit 297 operatively connected to the weighing unit to be hereinafter described.

From the description thus far of the modification shown in Fig. 18 it will be observed that during the second period of a cycle of operation of the machine, a previously weighed load contained in the weighing bucket 230 is released into the receptacle 238 whereupon the shutter 239 is again closed; the vibratory feeder 234 is started; and the cutoff blade 237 is opened to permit material to flow in a stream into the weighing bucket 230. As illustrated in general in Fig. 18, the cantilever weighing unit indicated at 228 may comprise a weighing unit of the type illustrated and described in the United States patent to S. R. Howard, No. 2,678,185, dated May 11, 1954, and includes two upper and two lower relatively stiff cantilever springs 262, 264 of equal length, the leaf springs being connected at one end to a frame member 265 and the other end of the leaf springs being connected by a rigid tie member 267 to which the weighing bucket 230 is attached by straps 268. The weighing unit is also provided with a coil spring 270 arranged to exert a counterforce upon the spring beam and to support a portion of the weight of the load, and the unit is also provided with a piston operating in a dash pot, indicated generally at 272. Sensitive pneumatically operated control mechanism, indicated generally at 302 in Figs. 18 and 20, is arranged to cooperate with the cantilever weighing unit 228 for terminating the weighing operation when a predetermined weight is reached, such control mechanism including a pressure responsive amplification device having a jet portion 306 cooperating with a valve member 308 carried by and movable with the cantilever spring weighing unit 228 adapted to effect rapid tripping of the pneumatically operated latch mechanism 297 upon minute deflection of the spring weighing unit. The pressure responsive control device 302 may be of the same general type illustrated and described in the Howard Patent No. 2,678,185, and as shown in Fig. 20, may be connected to a source of compressed air by a pipe 310. Normally the valve member 308 is spaced slightly from the jet 306, and the construction of the pneumatically operated unit is such that a large pressure charge occurs upon minute movement of the valve member toward the jet member 306 when the cantilever spring beam is deflected through a correspondingly minute distance. The increase in pressure is arranged to move an arm 312 operating in a chamber 314, the arm having a valve for cooperation with the jet 315 of a pressure chamber 316 operatively connected by a pipe 318 to the pneumatically operated latch member 297. The pneumatically operated member 297 may include a chamber 320 having a spring pressed piston 322 operating therein, the air pressure normally retaining the latch member 300 in its latched position. In operation when the material deposited in the weighing bucket reaches a predetermined weight, the increase in pressure in the chamber 314 will move the arm 312 to the right, as in Fig. 20, thus exposing the opening in the jet 315 and reducing the pressure in the chamber 316 permitting the piston to be spring operated to release latch 300 and permit the cutoff blade 237 to be closed.

Provision is also made in the preferred embodiment of the invention for maintaining the cantilever spring beam in its locked or inoperative position during the release of the material from the weighing bucket 230 and during the initial flow of the material into the weighing bucket, the beam being unlocked during the weighing period to effect operation of the pressure responsive amplification device 302 when the predetermined weight is reached. As herein shown, the scale lock may comprise a chamber 324 having a spring pressed plunger 326 arranged to engage the underside of the weighing beam, the chamber 324 being connected by a pipe 328 to the compressed air supply pipe 310. The pipe 328 is also provided with a cam operated valve 330 having a roller 332 for cooperation with a cam 334 fast on the cam shaft 252. In operation the valve 330 is normally open so that the air pressure will maintain the weighing beam locked, and at a predetermined time in the cycle the cam 334 operates to close the valve 330 and open the line 328 to the atmosphere, thus reducing the pressure in the chamber 324 and permitting the plunger 326 to be spring pressed downwardly to unlock the weighing beam.

Provision is also made for opening the circuit 245 to the relay 244 to discontinue the operation of the vibratory motor 266 and to reset the switches 246, 250 when the predetermined weight is reached, and as herein shown, a second pressure chamber 336 having a valve arm 338 movable therein is arranged to cooperate with a second jet 340 in communication with the pressure chamber 316. The jet 340 is connected by a pipe 342 to a pneumatically operated unit having a spring pressed plunger 344 cooperating with a microswitch 346 forming a part of the relay circuit 245, and in operation when the pressure in the chamber 336 is increased to a predetermined point corresponding to a predetermined weight the valve arm 338 is moved away from the jet 340 to reduce the pressure in the chamber 316 permitting the plunger 344 to be spring returned and permitting the switch 346 to be opened, thus terminating the second period in the cycle of operation of the vacuum filling machine, in readiness for a succeeding cycle of operation upon manual pressing of the push button 251, as described. It will be understood that the predetermined weight is normally reached prior to the end of the revolution of the cam 252 so that after the predetermined weight is reached the weighing beam is again locked by operation of cam 334 to open valve 330.

Referring now to Figs. 24 to 31, the embodiment of the invention therein illustrated includes volumetric load forming mechanism, indicated generally at 350, arranged to form successive measured loads which are deposited into the open top of a receptacle 352 having its lower end in communication with the inlet of the filling head 18 of the vacuum filling mechanism. The vacuum filling mechanism in the embodiment of the invention shown in Fig. 24 may and preferably will comprise the vacuum filling mechanism shown in Fig. 1, and may include the correspondingly numbered parts comprising the filling head 18, shroud 20, platform 22 and elevating mechanism 24. The control mechanism and driving mech-

anism therefor, indicated generally at 354, may also comprise the corresponding mechanism shown in Fig. 1 and includes a one revolution shaft 356 for controlling the cam operated valves in the housing 358 whereby to control the elevation of the container into the shroud and to effect vacuum filling thereof, as described. As also previously described, the vacuum filling operation is performed during the initial period in a cycle of operation by withdrawing a previously formed load from the receptacle 352, and upon completion of the vacuum filling operation the load forming operation is initiated by a cam operated switch arranged to be closed as the one revolution shaft 356 approaches the end of its one revolution. As above described, the cam operated switch energizes a relay, releasing a one revolution clutch 360 for initiating operation of a one revolution shaft 362 forming a part of the control mechanism 364 for the volumetric load forming mechanism 350. As herein shown, the one revolution clutch 360 is operatively connected by a chain and sprocket drive 366 to a motor 368.

The volumetric load forming mechanism shown in Fig. 24 includes a supply hopper 370 having spaced outlet legs 371, 372 terminating in openings in an upper tie plate 374 extended between the side frames 12 and provided with an elongated grooved guideway 376 on its underside. A lower tie plate 378 vertically spaced from the tie plate 374 is arranged to support the upper open end of the receptacle 352 and is provided with an elongated grooved guideway 380 in its upper surface. A slide member 382 carrying two spaced volumetric chambers 384, 386, open at top and bottom, is arranged to be reciprocated in said guideways 378, 380 whereby to present the chamber 384 in alignment with the supply hopper leg 371 to receive a measured load of material and to present the chamber 386 in alignment with the receptacle 352 to permit a previously measured load of material to fall into the receptacle during one cycle of operation of the machine. Thereafter, during a succeeding cycle of operation the slide member 382 is shifted to present the chamber 384 in alignment with the receptacle 352 to release its measured load and to present the chamber 286 in alignment with the leg 372 of the supply hopper to receive another measured load. Thus, in operation the volumetric measuring chambers 384, 386 are alternately filled and emptied during successive cycles of operation of the vacuum filling machine. It will be understood that the elongated plate forming the upper portion of the slide member 382 effects closing of the leg 372 when the chambers are moved to the left in Fig. 25 and effects closing of the leg 371 when the chambers are moved to the right.

Provision is made for pneumatically reciprocating the slide member 382 to alternate the positions of the chambers 384, 386 during succeeding cycles of operation. As herein shown, a lever 390 pivotally mounted at 392 is connected at its upper end by a pin and slot connection 393 to a bar 394 extending between and attached to the chambers 384, 386. The lever 390 is arranged to be rocked by an air motor 396 having a piston 398 operating in a chamber 399, the stem of the piston being connected by a link 400 to the lever 390. The air motor 396 is arranged to be controlled by a rotary valve 402 keyed to a shaft 404 and operating in a housing 406. The rotary valve is provided with a diametral opening 408 which extends through the shaft 404, and as shown in Fig. 30, the shaft is provided with a communicating central passageway 409 connected by a pipe 410 to a source of compressed air. In the position shown in Fig. 29, the diametral opening 408 is in communication with passageways 416, 418 formed in the housing, the passageways being connected by branch pipes 420, 422 respectively to a pipe 424 leading to one end of the chamber, as shown in Fig. 28, to effect movement of the piston 398 to the left and thus through the linkage described to move the measuring chambers 384, 386 to the left. During movement of the piston 398 to the left the air in the left hand side of the chamber 399 is discharged through a pipe 426, branch pipes 428, 430, passageways 432, 434 in the housing which communicate with passageways 436, 438 respectively in the rotary valve 402, the passageways 436, 438 being aligned in the position shown in Fig. 29, with atmospheric openings 440, 442 respectively formed in the housing.

Provision is made for rotating the valve 402 ninety degrees each cycle of operation to reverse the operation of the air motor 396 and to shift the measuring chambers 384, 386 to the right, such rotation being effected upon initiation of rotation of the one revolution shaft 362 through a chain and sprocket drive 444 to the input shaft of a gear reduction unit 446, the rotary valve 402 being keyed to the output shaft 404 of the gear reduction unit, as shown in Figs. 25 and 27. When thus rotated through ninety degrees from the position shown in Fig. 29, the diametral opening 408 will be in alignment with opposed passageways 432, 434 to cause the flow of compressed air through branch pipes 428, 430 and pipe 426 to the chamber 399 to effect movement of the piston 398 and the measuring chambers 384, 386 to the right, the air on the right hand side of the piston being permitted to escape through the pipe 424, branch pipes 420, 422, passageways 416, 418 in the housing, and passageways 436, 438 in the valve which at this time will be aligned with atmospheric openings 448, 450 in the housing.

Thus, in the operation of the modified form of the machine shown in Fig. 24 it will be seen that after a volumetrically formed measured load has been withdrawn by vacuum from the receptacle 352 and deposited into the container 34 during one period in a cycle of operation of the vacuum filling machine, the lower control mechanism 354 is arranged to initiate rotation of the one revolution shaft 362 of the upper control mechanism 364 whereupon the volumetric measuring chambers are shifted to empty one chamber containing a previously formed load into the receptacle 352, the other chamber receiving a new load from the supply hopper and the measuring chambers being shifted from one leg of the hopper to the other during alternate cycles of operation.

From the above description it will be seen that the present vacuum filling machine is capable of preforming and depositing successive uniform loads into successive containers and without sealing engagement with the mouth of the container, and that as a result the present vacuum filling machine is particularly adapted for filling uniform loads into containers which may vary in size or shape, and for filling flexible containers, such as paper bags, wherein difficulties formerly encountered in attempting to make an airtight seal with the mouths thereof are eliminated and which are also subject to variation in size or shape or to deformation such as to vary the volume thereof.

While the preferred embodiment of the invention has been herein illustrated and described it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In a vacuum filling machine for handling finely divided solid material, in combination, vacuum filling means including a filling head and a shroud enclosing the container to be filled, the filling head having a material inlet opening, means for evacuating the shroud, means for forming and storing a preformed, predetermined load of the material including a volumetric vacuum filled receptacle, and means connected therewith and operating in response to the vacuum in the shroud for drawing the preformed load through the material inlet and into a container supported in the shroud, the material in said receptacle being under atmospheric pressure during drawing of the material therefrom into the container.

2. In a vacuum filling machine for handling finely

divided solid material, in combination, container supporting means, vacuum filling means including a vacuum filling head having a suction opening and a material inlet opening, said filling head and said supporting means cooperating to form a vacuum chamber enclosing and supporting the container with the mouth of the container in non-sealing relation to the filling head and to said material inlet opening, means for evacuating said chamber, a receptacle operatively connected to said material inlet opening, and vacuum operated means for forming and depositing a predetermined load of material into said receptacle to be withdrawn and introduced into the container upon evacuation of said vacuum chamber during the vacuum filling operation, the material in said receptacle being under atmospheric pressure during the withdrawing operation.

3. In a vacuum filling machine for handling finely divided solid material, in combination, container supporting means including an elevating platform, vacuum filling means including a vacuum filling head having a suction opening and a material inlet opening and provided with a depending shroud portion, means for elevating said container supporting platform into sealing engagement with said shroud portion to form a vacuum chamber enclosing said container with the mouth of the container in non-sealing relation to the filling head and said material inlet opening, means for evacuating said chamber, a supply of the material, a receptacle operatively connected to said material inlet opening, and vacuum operated means for forming from said supply a predetermined load of material and depositing the same into said receptacle to be withdrawn and introduced into the container upon evacuation of said chamber during the vacuum filling operation, the material in said receptacle being under atmospheric pressure during the withdrawing operation.

4. In a vacuum filling machine for handling finely divided solid material, in combination, vacuum filling means including a filling head and a shroud enclosing the container to be filled, the filling head having a material inlet opening, means for evacuating the shroud, vacuum operated means including a receptacle for forming and storing a preformed, predetermined load of the material, and means connected therewith and operating in response to the vacuum in the shroud for drawing the preformed load through the material inlet and into a container supported in the shroud, the material in said receptacle being under atmospheric pressure during drawing of the material therefrom into the container, and control means actuated upon completion of the container vacuum filling operation for initiating operation of said vacuum operated load forming means to deposit a preformed load into said receptacle for a succeeding vacuum filling operation.

5. A vacuum filling machine as defined in claim 4 wherein the material inlet opening is provided with a normally closed valve and with means for opening said valve during the vacuum filling operation.

6. In a vacuum filling machine, in combination, container supporting means, vacuum filling means including a vacuum filling head having a suction opening and a material inlet opening, said filling head and said supporting means cooperating to form a vacuum chamber enclosing and supporting the container with the mouth of the container in non-sealing relation to the filling head and to said material inlet opening, means for evacuating said chamber, a receptacle operatively connected to said material inlet opening, and means for forming and depositing a predetermined load of material into said receptacle to be withdrawn and introduced into the container upon evacuation of said vacuum chamber during the vacuum filling operation, said load forming means including a volumetric vacuum filled receptacle operatively connected to a supply of the material for measuring said predetermined load, said vacuum filled receptacle being open to the atmosphere during the withdrawing operation.



7. In a vacuum filling machine, in combination, container supporting means including an elevating platform, vacuum filling means including a vacuum filling head having a suction opening and a material inlet opening and provided with a depending shroud portion, means for elevating said container supporting platform into sealing engagement with said shroud portion to form a vacuum chamber enclosing said container with the mouth of the container in non-sealing relation to the filling head and said material inlet opening, load preforming means including a volumetric vacuum filled receptacle operatively connected to said material inlet and provided with a filling head having a suction opening and a supply inlet connected to a supply of material for measuring said predetermined load, said container vacuum filling means including means for evacuating the chamber and for withdrawing the preformed load from the receptacle into the container, means for evacuating the receptacle to withdraw material from the supply into the receptacle, normally closed valve means in said supply inlet and said material inlet respectively, means for operating said valves to open the supply valve during the receptacle filling operation and for opening the material inlet valve during the container filling operation, and means for opening said receptacle to the atmosphere during the withdrawal of the material therefrom into the container.

8. A vacuum filling machine as defined in claim 7 which includes control means actuated upon completion of the container vacuum filling operation for initiating the receptacle vacuum filling operation to provide a preformed load in the receptacle for a succeeding container filling operation.

9. In a vacuum filling machine for filling containers with finely divided material, in combination, container supporting means, a vacuum filling head having a suction opening and a material inlet opening, said filling head and said supporting means cooperating to form a vacuum chamber enclosing the container with the mouth of the container in non-sealing relation to the filling head and said material inlet opening, a receptacle operatively connected to said material inlet opening for the reception of a preformed load of material, and means for evacuating said chamber to effect withdrawal of the preformed load from the receptacle and introduction into the container, said container supporting means comprising a platform having raised portions spacing the bottom of the container from the platform, said vacuum chamber being provided with a relatively small atmospheric opening disposed in said platform with relation to said suction opening to cause a flow of air about the exterior surfaces of the container including the bottom and side walls thereof during the vacuum filling operation to prevent an accumulation of comminuted material thereon, the material in said receptacle being open to the atmosphere during withdrawal thereof into the container.

10. In a vacuum filling machine for handling finely divided solid material, in combination, vacuum filling means including a shroud having a filling head in the upper end thereof and means for supporting a container to be filled in operative filling position beneath the filling head, said filling head being provided with a material inlet opening, means for evacuating the shroud, means for forming a predetermined load of material including a receptacle disposed above the filling head and having the lower portion thereof provided with an outlet, a substantially straight conduit connected to said outlet and the inlet opening in the filling head and through which said predetermined load of finely divided solid material may be caused to flow under the influence of gravity and the vacuum in the shroud into said container, and an inflatable valve in said straight conduit for controlling the flow of material therethrough, the material in said

receptacle being open to the atmosphere during flow of the material therefrom into the container.

11. In a vacuum filling machine for handling finely divided solid material, in combination, vacuum filling means including a filling head and a shroud, means for supporting a container to be filled below the filling head and within the shroud, means for evacuating the shroud, means for storing a supply of the finely divided material in an elevated position, a measuring receptacle disposed above the vacuum filling means, a straight conduit connecting the elevated storage means and said measuring receptacle and through which the finely divided solid material may readily flow into the receptacle, said receptacle having an outlet in the lower portion thereof, and a straight conduit connecting said outlet with the inlet opening of the filling head and through which said predetermined load of finely divided solid material may be caused to flow by gravity and in response to the vacuum in the shroud, the material in said receptacle being open to the atmosphere during flow of the material therefrom into the container.

12. In a vacuum filling machine for filling containers with finely divided material, in combination, container supporting means, vacuum filling means including a vacuum filling head having a shroud provided with a suction opening and a material inlet opening, said shroud of said filling head and said supporting means cooperating to form a vacuum chamber enclosing and supporting the container with the mouth of the container in non-sealing relation to the filling head and to said material inlet opening, means for evacuating the shroud, a receptacle operatively connected to said material inlet opening, means for forming and depositing a predetermined load of finely divided material into said receptacle to be withdrawn and introduced into the container upon evacuation of said vacuum chamber during the vacuum filling operation, said load preforming means including means for weighing a predetermined load of material, and means for depositing the weighed load into said receptacle.

13. A vacuum filling machine as defined in claim 12 which includes control means actuated upon completion of the vacuum filling operation for initiating the weighing operation to provide a preformed weighed load in said receptacle for a succeeding weighing operation.

14. In a vacuum filling machine for filling containers with finely divided material, in combination, container supporting means, vacuum filling means including a vacuum filling head having a shroud provided with a suction opening and a material inlet opening, said shroud of said filling head and said supporting means cooperating to form a vacuum chamber enclosing and supporting the container with the mouth of the container in non-sealing relation to the filling head and to said material inlet opening, means for evacuating the shroud, a receptacle operatively connected to said material inlet opening, means for forming and depositing a predetermined load of finely divided material into said receptacle to be withdrawn and introduced into the container upon evacuation of said vacuum chamber during the vacuum filling operation, said load preforming means including means for volumetrically measuring a predetermined load of material, and means for depositing the measured load into said receptacle.

15. A vacuum filling machine as defined in claim 14 wherein the volumetric measuring means includes a supply hopper having spaced legs, a pair of spaced measuring chambers open at top and bottom, one of said chambers being aligned with one of said legs to receive a load and the other chamber being aligned with said receptacle to empty its load in one position of operation, and means for reciprocating said chambers to align said first chamber with the receptacle and the second chamber with the other leg of the supply hopper during alternate cycles of operation.

16. A vacuum filling machine as defined in claim 15 which includes control means actuated upon completion of the vacuum filling operation for initiating reciprocation of said volumetric measuring chambers to provide a preformed measured load in the receptacle for a succeeding container filling operation.

17. In a vacuum filling machine for filling containers with finely divided material, in combination, container supporting means, a vacuum filling head having a shroud provided with a suction opening and a material inlet opening, said shroud of said filling head and said supporting means cooperating to form a vacuum chamber enclosing the container with the mouth of the container in non-sealing relation to the filling head and said material inlet opening, a receptacle operatively connected to said material inlet opening for the reception of a preformed load of finely divided material, means for forming and depositing a predetermined load of material into said receptacle, and means for evacuating said chamber to effect withdrawal of the preformed load from the receptacle and introduction into the container.

18. In a vacuum filling machine, in combination, container supporting means including an elevating platform, vacuum filling means including a vacuum filling head having a suction opening and a material inlet opening and provided with a depending shroud portion, means for elevating said container supporting platform into sealing engagement with said shroud portion to form a vacuum chamber enclosing said container with the mouth of the container in non-sealing relation to the filling head and said material inlet opening, means for evacuating the shroud, a receptacle operatively connected to said material inlet opening, and means for forming and depositing a predetermined load of material into said receptacle to be withdrawn and introduced into the container upon evacuation of said chamber during the vacuum filling operation, the portion of the filling head defining the material inlet opening being extended downwardly to be loosely inserted into the container during the elevating operation whereby to support a fragile container during the vacuum filling operation.

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